

# Unique Solidification Cracking Mechanism in Ultra-Low Interstitial Iron and Iron Alloy Weld Metal

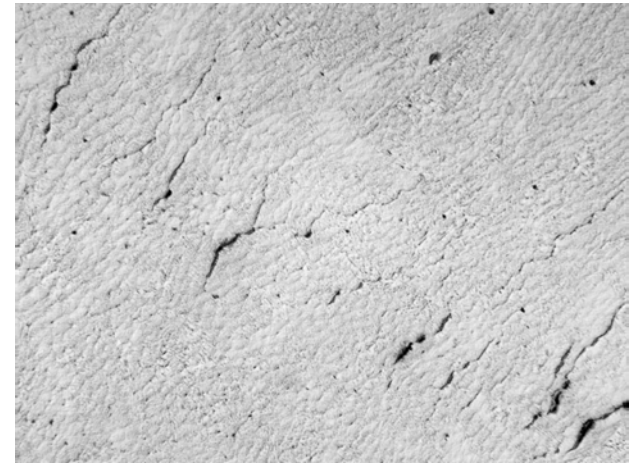
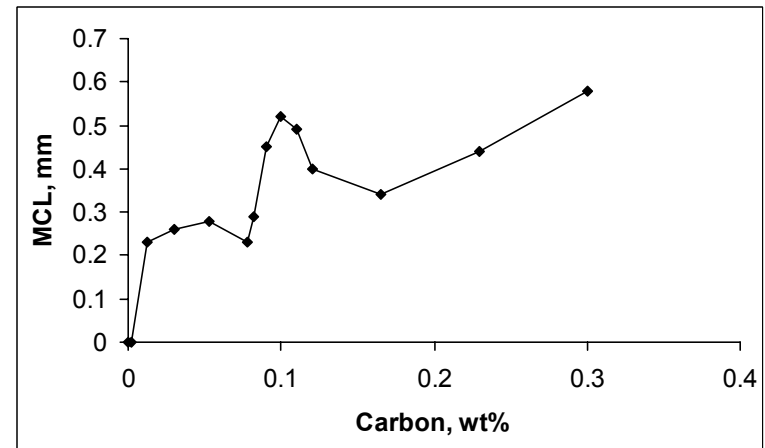
Jack H. Devletian, Portland State University, DMR Award #9972052

## Motivation

- Why solidification cracking in low-C steel welds? Not expected from theories.

## Complex C-Fe Interaction

- Effects of C on solidification cracking are complex and non-linear
  - Cracking peak at ~0.1%C-Fe (figure)
- Unique cracking mechanism at 0.1%C-Fe is due to simultaneous action of:
  - $\delta/\gamma$  transformation stresses
  - Brittle temperature range
  - Max solidus/liquidus temperature range of Fe-C peritectic
- Ni and B alloying further complicates carbon's effect on cracking



Solidification cracking in Fe-0.1C weld metal produced by standard trans-varestraint test. "MCL" is max crack length.

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## Broad Impact

- Upcoming publications will advise fabricators of weld cracking peak for 0.1%C steel weld metal.
- New cracking test developed to correlate:
  - Solidification cracking
  - Load drop (blue)
  - Acoustic emission (green & red)
- Important for welding of ships, bridges, and other structures.

## Education

- Two MS students graduated.

## International Collaboration

- Dr. V. Shankar, Post-Doc from Indira Gandhi Centre for Atomic Research, conducted research for 7 months at Portland State University.

## New Solidification Cracking Test

